Report from the Airplane Performance Harmonization Working Group

Issue: Accounting for the effect of snow, slush, standing water, and ice-covered runways on takeoff performance (with engine failure accountability)

Rule Section: FAR 121.189, 135.379/JAR-OPS 1.485, 1.490

1 - What is the underlying safety issue to be addressed by the FAR/JAR? [Explain the underlying safety rationale for the requirement. Why should the requirement exist? What prompted this rulemaking activity (e.g., new technology, service history, etc.)?]

It is fundamental to operational safety that the pilot should be able to either safely complete a takeoff or bring the airplane to a complete stop within the remaining distance available for stopping the airplane, even if power is lost from the most critical engine just before the airplane reaches a defined go/no-go point. This principle has formed the basis of the takeoff performance standards required for the type certification and operation of turbine engine powered transport category airplanes since Special Civil Air Regulation No. SR-422, effective August 27, 1957. As of March 20, 1997, the application of this principle was extended by the “commuter rule” to also cover scheduled passenger-carrying operations conducted in airplanes that have a passenger seat configuration of 10 to 30 passengers and turbojet airplanes regardless of seating configuration.

The defined go/no-go point during the takeoff is provided to the pilot as a speed called V_1. Up to the V_1 speed, the pilot should be able to reject a takeoff and stop within the remaining stopping distance. After V_1, the pilot should be able to safely continue the takeoff, even if an engine fails just prior to V_1.

The presence of snow, slush, ice, or standing water on the runway has a significant effect on an airplane’s takeoff performance capability. Snow, slush, or standing water can greatly reduce an airplane’s acceleration capability due to the drag caused by the tires running through the contaminant (displacing it), and by the impingement of the contaminant spray on the airplane. All four types of contaminant seriously reduce the capability of the airplane to stop in the event of a rejected takeoff and all but ice will reduce the acceleration capability of the airplane. These degradations of airplane performance capability significantly erode the safety margins that would exist if the runway were clear and dry. If these performance effects are not taken into account when determining the maximum takeoff weight and associated V_1 speed, the airplane may not be able to stop within the available stopping distance if the takeoff is rejected from near the V_1 speed, or safely continue the takeoff if an engine fails near the V_1 speed.

2 - What are the current FAR and JAR standards relative to this subject? [Reproduce the FAR and JAR rules text as indicated below.]

Current FAR text:

Part 121

FAR 121.189 Airplanes: Turbine engine powered: Takeoff limitations.

(c) No person operating a turbine engine powered airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that listed in the Airplane Flight Manual at which compliance with the following may be shown:

(1) The accelerate-stop distance must not exceed the length of the runway plus the length of any stopway.

(2) The takeoff distance must not exceed the length of the runway plus the length of any clearway except that the length of any clearway included must not be greater than one-half the length of the runway.

(3) The takeoff run must not be greater than the length of the runway.

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(e) In determining maximum weights, minimum distances, and flight paths under paragraphs (a) through (d) of this section, correction must be made for the runway to be used, the elevation of the airport, the effective runway gradient, the ambient temperature and wind component at the time of takeoff, and, if operating limitations exist for the minimum distances required for takeoff from wet runways, the runway surface condition (dry or wet). Wet runway distances associated with grooved or porous friction course runways, if provided in the Airplane Flight Manual, may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay, and that the operator determines are designed, constructed, and maintained in a manner acceptable to the Administrator.

Part 135

FAR 135.379 Large transport category airplanes: Turbine engine powered: Takeoff limitations.

(c) No person operating a turbine engine powered large transport category airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that listed in the Airplane Flight Manual at which compliance with the following may be shown:

(1) The accelerate-stop distance must not exceed the length of the runway plus the length of any stopway.

(2) The takeoff distance must not exceed the length of the runway plus the length of any clearway except that the length of any clearway included must not be greater than one-half the length of the runway.

(3) The takeoff run must not be greater than the length of the runway.

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(e) In determining maximum weights, minimum distances, and flight paths under paragraphs (a) through (d) of this section, correction must be made for the runway to be used, the elevation of the airport, the effective runway gradient, the ambient temperature and wind component at the time of takeoff, and, if operating limitations exist for the minimum distances required for takeoff from wet runways, the runway surface condition (dry or wet). Wet runway distances associated with grooved or porous friction course runways, if provided in the Airplane Flight Manual, may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay, and that the operator determines are designed, constructed, and maintained in a manner acceptable to the Administrator.

Current JAR text:

JAR-OPS 1.485 General

(a) An operator shall ensure that, for determining compliance with the requirements of this subpart, the approved performance data in the Aeroplane Flight Manual is supplemented as necessary with other data acceptable to the Authority if the approved performance data in the Aeroplane Flight Manual is insufficient in respect of items such as:

(1) Accounting for reasonably expected adverse operating conditions such as take-off and landing on contaminated runways; and

(2) Consideration of engine failure in all flight phases.

(b) An operator shall ensure that, for the wet and contaminated runway case, performance data determined in accordance with JAR 25X1591 or equivalent acceptable to the Authority is used. (See IEM OPS 1.485(b).)

JAR-OPS 1.490 Take-off

(b) An operator must meet the following requirements when determining the maximum permitted take-off mass:

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(5) On a wet or contaminated runway, the takeoff mass must not exceed that permitted for a take-off on a dry runway under the same conditions.

(c) When showing compliance with sub-paragraph (b) above, an operator must take account of the following:

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(3) The runway surface condition and the type of runway surface (see IEM OPS 1.490(c)(3));

2a – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed? [Reproduce text from issue papers, special conditions, policy, certification action items, etc., that have been used relative to this issue]

N/A

3 - What are the differences in the FAA and JAA standards or policy and what do these differences result in? [Explain the differences in the standards or policy, and what these differences result in relative to (as applicable) design features/capability, safety margins, cost, stringency, etc.]

Currently, the Part 121/135 operating rules do not specifically require that runway surface contamination in the form of ice, snow, slush, or standing water be taken into account in determining allowable takeoff weights. FAA Advisory Circular 91-6A provides information, guidelines, and recommendations for conducting turbojet operations on runways covered by water, snow, or slush, but it is not mandatory. FAA order 8400.10, "Air Transportation Operations Inspector's Handbook," notifies FAA Operations Inspectors to consult this AC for operations on runways that have snow, slush, ice, or standing water because such conditions "typically require corrections for takeoff calculations." Although Inspectors are advised that the effects of contaminated runways, must be accounted for, there is no FAR that explicitly requires this.

In contrast to the FAA requirements, JAR-OPS 1 requires runway surface contamination in the form of ice, snow, slush, or standing water to be taken into account in determining allowable takeoff weights for all Performance Class A airplanes used in commercial air transportation. (Performance Class A airplanes include multi-engine turbopropeller airplanes with a maximum approved passenger seating configuration of more than 9 seats or a maximum takeoff mass exceeding 5700 kilograms, and all multi-engine turbojet powered airplanes.) In addition, JAR-OPS 1 requires operators to ensure that the contaminated runway data being used has been developed in accordance with certain criteria provided in JAA advisory material or their equivalent. The JAR standard takes into account a failure of the most critical engine just before the airplane reaches a defined go/no-go point, just like for the dry or wet runway case. JAR-OPS 1 also requires the operator to ensure that the approved performance data in the Airplane Flight Manual

(AFM) is supplemented as necessary with other data acceptable to the Authority if the AFM lacks contaminated runway data, including the consideration of engine failure.

The JAR standards provide a higher level of safety than the FAR when operating from runways contaminated by standing water, slush, ice, or snow. In achieving this higher level of safety, the JAR standards impose an economic burden on JAR operators that is not borne by FAR operators.

4 - What, if any, are the differences in the current means of compliance? [Provide a brief explanation of any differences in the current compliance criteria or methodology (e.g., issue papers), including any differences in either criteria, methodology, or application that result in a difference in stringency between the standards.]

N/A – The FAR does not contain a standard for takeoff performance limitations from contaminated runways, so there is no applicable means of compliance. Guidance published by the FAA in AC 91-6A for operations on contaminated surfaces differs from the compliance criteria used by the JAA in that it does not provide a specific methodology for determining an airplane's takeoff performance on contaminated surfaces.

5 – What is the proposed action? [Describe the new proposed requirement, or the proposed change to the existing requirement, as applicable. Is the proposed action to introduce a new standard, or to take some other action? Explain what action is being proposed (not the regulatory text, but the underlying rationale) and why that direction was chosen for each proposed action.]

The Performance Harmonization Working Group did not reach a consensus on this issue. Because the performance effects of contaminated runways are severe, the economic impact of taking them into account can be significant. Takeoff weight can be severely restricted, which can lead to a loss of revenue if the cargo or passenger payload must be reduced. In some cases, operations would no longer be economically viable. Some members of the working group considered the resulting economic penalty to be too large in relation to the potential safety benefit to recommend harmonization to the JAA requirements.

The working group investigated the potential for reducing this economic burden while maintaining the safety benefits, including data analysis, presentation, and performance calculation methods, differentiation of contaminant types, depths, and frequency of occurrence, and runway clearing and condition reporting practices. Subgroups were formed to examine each of these issues and report to the working group. The subgroups' conclusions regarding each of these issues are provided separately (Subgroup reports 1 and 2), but the end result was that there was little likelihood of significantly reducing the economic burden associated with accounting for the effects of contaminated runways on takeoff performance when engine failure accountability is included.

Therefore, the working group is submitting two different reports regarding rulemaking proposals for this issue. One report (this one) proposes harmonizing on the JAR standard, including accountability for engine failure. The other report (Working Group Report 5) proposes adopting contaminated runway takeoff limitations into the FAR that would not include engine failure accountability.

Harmonizing to the JAA requirements espoused in JAR-OPS 1, including accountability for an engine failure during the takeoff, is proposed for the following reasons:

1. Harmonization of this issue is an important safety and economic issue. Safety margins are seriously degraded by the presence of slush, snow, ice, or standing water on the runway. Without harmonization, the same type of airplane taking off from the same runway under the same conditions could have significantly different safety margins and revenue generating capability, subject to whether it is being operated by a FAR or JAR operator. This significant difference in safety and revenue generating capability is precisely what the Performance Harmonization Working Group was tasked to try to eliminate.

2. As stated in the preamble of Notice of Proposed Rulemaking 93-8 (58 FR 36738), "it is fundamental to operational safety that the pilot should be able to either safely complete the takeoff, or bring the airplane to a complete stop if a decision is made to reject the takeoff no later then the V_1 speed, even if power is lost from the most critical engine just before V_1." This principle is part of the underlying safety objective of both the FAR and the JAR to provide safety margins for an engine failure occurring at any point in the flight. To accept that an engine failure need not be taken into account for contaminated runway takeoffs would undermine this philosophy.

   If takeoff performance is based on all engines operating throughout the takeoff, there would be an exposure period for runway-limited takeoffs such that the pilot would be unable to either safely complete the takeoff if power were lost from the critical engine or bring the airplane to a complete stop for any reason within the length of the remaining runway. In this situation, the maximum speed from which the airplane could be brought to a complete stop on the runway would be lower than the minimum speed from which the airplane could takeoff and reach a height of 15 feet over the end of the runway after an engine failure. Attempting to stop for any reason during this exposure period would result in an overrun, while continuing the takeoff if an engine fails during the exposure period would likely result in the airplane being unable to safely complete the takeoff.

   In addition to violating the basic principle of retaining the capability to either takeoff or stop on the runway in the event of an engine failure, there is the question of what information to provide to the pilot if takeoff limitations were based on all engines operating throughout the takeoff. Currently, pilots are provided with a V_1 speed, which is defined as "the maximum speed in the takeoff at which the pilot must take the first action (e.g., apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance [and] the minimum speed in the takeoff, following a failure of the critical engine at V_{EF}, at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance." The V_1 concept would no longer be valid for takeoffs in which an engine failure is not taken into account. Maximum "stop" and minimum "go" speeds could be provided, which would be the maximum speed from which the airplane could be stopped on the runway, and the minimum speed from which a takeoff could be safely continued after an engine failure, respectively. But this would be a significant departure from what pilots are accustomed to for typical day-in day-out operations, and there would be the further question of what to recommend to the pilot for a problem occurring in the exposure period between these speeds. If only the maximum stop speed is provided, as has been proposed in Working Group Report 5, the pilot is likely to attempt to continue the takeoff if an engine fails near that speed, which could prove disastrous.

3. Statistics presented in the Takeoff Safety Training Aid, developed jointly by the aviation industry and the FAA in 1992, and supplemented by Boeing in 2000 (Boeing *Aero* Magazine, July 2000) show that 9 percent of the rejected takeoff accidents/incidents for which runway conditions were reported occurred on contaminated runways. (Runway conditions were not reported for 29 percent of the rejected takeoff accidents.) Since it is estimated that significantly fewer than 9 percent of takeoffs are made from contaminated runways (see item 16 of this report), the risk of a rejected takeoff accident is disproportionately greater on a contaminated runway than on a dry runway. Although it is inconclusive whether the standards proposed in this report would have prevented or minimized the effects of the known accidents/incidents, the proposed standards would increase the level of safety for all takeoffs from contaminated runways.

   In Working Group Report 5 (opposing engine failure accountability on contaminated runways), the point is made that there has not been a single rejected takeoff overrun accident identified in the rejected takeoff data referenced above where the action to stop the airplane was known to have been initiated before or at V_1 (whether due to engine failure or other reasons) and the runway conditions were reported as snow, ice or slush. From this observation, the authors of that report conclude that imposing engine-inoperative performance standards would not have prevented any of the known accidents/incidents for takeoffs from contaminated runways.

   However, such a conclusion does not necessarily follow from the data. Accounting for contaminated runway conditions on an engine failure basis would have resulted in a lower takeoff weight, lower V_1 speed, and improved airplane acceleration and stopping capability. With the lower V_1 speed, would the crew(s) have made the same decision to reject the takeoff? With the improved performance, could the takeoff have been safely continued or safely rejected? It is difficult to draw any conclusions about whether the proposed engine-inoperative contaminated runway performance standards would or would not have prevented any of the known accidents/incidents. At the very least, the severity of an overrun would be reduced. In any case, safety margins would be provided for contaminated runway takeoffs that are consistent with those present for dry and wet runway takeoffs.

Another important point that must be made in regards to the in-service data is that there is no way to tell from the data whether there have been accidents prevented by the use of engine-out contaminated runway data. Data for successful rejected takeoffs is not included in the database referenced in this report and Report 5.

4. Those opposed to including engine failure accountability for the contaminated runway case contend that, due to the infrequency of operations on contaminated runways and the low probability of an engine failure occurring during the time period that would prevent the airplane from both taking off and stopping within the runway length, engine failure accountability can be ignored on a probability basis. Not accounting for an engine failure on a probability basis, however, treats a contaminated runway condition in the same manner as a failure condition, or other randomly occurring variable. But runway contamination is a readily identifiable nonrandom operating condition, no different than other variables that are fully taken into account for takeoff, such as wind, runway slope, temperature, density altitude, etc. Not accounting for an engine failure on contaminated runways would be akin to not accounting for engine failure on extremely hot days, or at very high altitude airports.

   The infrequency of contaminated runway conditions reduces the economic impact of the harmonized standards proposed in this report. The severe performance penalties associated with contaminated runway conditions confirms that this is a significant safety issue.

5. In general, contaminated runway operations are infrequent and transitory, which tends to mitigate the economic burden. Also, unlike many other variables adversely affecting takeoff performance, like density altitude and temperature, action can usually be taken to remove or reduce the level of runway contaminant. The economic penalty can be reduced or eliminated by waiting until the runway is cleared or conditions otherwise improve.

   In Working Group Report 5 it is suggested that introducing engine-inoperative contaminated runway accountability may actually decrease safety by diverting passengers from air travel to automobile travel when flights are delayed or canceled due to contaminated runway conditions. However, it is difficult to envisage a situation where a significant number of passengers would, when faced with a flight delay due to severe winter conditions, be prepared to and choose to drive under those conditions. In addition, as indicated by the examples cited in Report 5, it is typically the long haul flights, where it would be impractical to drive instead of flying, that would be impacted most severely in terms of potential passenger offloads, delays, or flight cancellations.

The impact of one-engine-inoperative contaminated runway requirements, in terms of flight delays and cancellations, is unlikely to be anywhere near as great as those already occurring as a result of other severe weather conditions (e.g., summer thunderstorms or dense fog), mechanical problems, or air traffic scheduling constraints.

6. Of the different types of runway surface contamination, slush causes a considerably larger performance penalty. And the greater the depth of contaminant, the larger the penalty (an exception being when the maximum allowable takeoff weight is limited by minimum control speed considerations). In general, however, slush is the least frequently occurring condition and is the most transitory type of runway contaminant. Yet, those opposed to full engine failure accountability on contaminated runways continue to cite takeoff weight penalties associated with the maximum depth of slush for which a takeoff can be made combined with being at or near the maximum allowable weight allowed for the runway length in dry conditions. This use of the data vastly overstates the potential revenue impact of the harmonized standards proposed in this working group report. The only complete revenue impact analysis of actual operating data during winter conditions is supplied as an attachment to this report. These data show that out of a total of 446,015 departures for this operator, 0.10 percent were from runways with one-quarter inch of contaminant and 0.02 percent were from runways with one-half inch of contaminant. Out of a total operating revenue of $4,735,587,000 in 1999, $190,739 (0.004% of operating revenue) was lost due to accounting for contaminated runways on a one-engine-inoperative basis. Restricting the analysis to the ten airports with the highest number of operations from contaminated runways, which included Detroit-Metro, Baltimore-Washington International, Chicago Midway, and Cleveland Hopkins, less than one-half of one percent of takeoffs were from runways with one-quarter inch of contaminant and less than one-tenth of one percent were from runways with one-half inch of contaminant.

7. Harmonization would “level the playing field” not only between FAR and JAR operators, but also among different FAR operators. Since the FAR does not currently require that contaminated runway conditions be taken into account, there are a variety of practices being employed in regards to contaminated runway takeoff performance.

8. Many of the same issues were dealt with during the process leading up to adoption of the JAR-OPS 1 contaminated runway requirements. The overall experience after adoption of these requirements has thus far not borne out projections of operations being curtailed because of the magnitude of the payload reductions, and has in some cases engendered a closer working relationship between airplane and airport operators to safely conduct operations under adverse weather conditions. The authors of this working group report do not consider the operating environment of FAR operators to be unique or significantly different than that of JAR operators as far as contaminated runway operations are concerned. From the standpoint of harmonizing the standards

to reduce competitive disparities, FAA/JAA operators competing on similar routes experience the same operating environment

9. Data availability should not be a problem. Except for very few instances of certain out-of-production airplanes, the data are readily available for operators to use to show compliance with the proposed harmonized requirements, including accounting for an engine failure. Even in these few instances, producing acceptable data is not considered to be a significant obstacle. This issue has already been addressed by the existence of the JAR-OPS 1 requirement to account for contaminated runway conditions on a one-engine-inoperative basis. Manufacturers produced appropriate data packages so that operators could show compliance with these requirements. It is intended that these same data packages would be acceptable to show compliance with the FAR requirements proposed in this report.

   It is recognized that existing data has been produced to differing standards, which, as noted in Subgroup Report 1, can have a large impact on the takeoff weight capability of an airplane on contaminated runways. Although different sets of data produced to differing standards may both be acceptable from a regulatory (safety) standpoint, the resulting airplane performance, and hence cost impact to operators, may be significantly different. There will be a strong desire by the operators for manufacturers to revise data that has been produced to standards more stringent than are necessary to be accepted by the regulatory authority. Revising the existing data will result in an additional cost to the airplane manufacturers, but would reduce the revenue impact of the proposed standards to operators. Presumably, any revision of existing data will only be undertaken if it will lessen the penalty to operators and can be provided for a positive net "cost." Therefore, although the adoption of the harmonized standards proposed in this report may result in the need to revise existing data, it can be assumed that such revisions will only occur if they result in a net benefit by lowering the potential revenue loss incurred by the adoption of contaminated runway takeoff performance limitations that include accountability for engine failure.

10. The Working Group did reach consensus on the position that expeditiously removing snow, slush, ice, and standing water from runways is a more effective manner of improving the safety of operations than by imposing airplane operating limitations alone. Currently, airport operators do not consider AC 150/5200-30A, "Airport Winter Safety and Operations," as more than just guidance information, and the FAA does not require its use. Until the FAA adopts specific requirements regarding the condition of contaminated runways, operators will continue to be faced with widely varying runway conditions in winter operations. This does not provide the consistent level of safety that is desired, and puts extreme pressure on operators and pilots to operate when exact airplane performance cannot be known. The working group recommends that the FAA update the requirements of § 139.313 to require that runways, including runway ends, high-speed turnoffs, and taxiways (consistent with AC150/5200-30A, and where the highest number of departures occur), be maintained

in a “no worse than wet” condition. That will also provide the incentive to airport operators aggressively seek the tools, methods, and cooperation they need with all parties to enhance the safety of winter operations.

These concerns extend to prospective all-engines standards or engine-out regulatory standards. Another ARAC Working Group should be tasked with an examination of runway surface reporting and clearing criteria.

History of Contaminated Runway Requirements in Europe

Some European operators accounted for engine failure on contaminated runways even before JAR-OPS 1 was adopted by JAA in 1995. These standards were introduced because: 1.) The European operators recognized that safety dictated that engine failure should be accounted for on contaminated runways, and 2.) In Europe, the frequency that runways are actually contaminated, resulting in a weight penalty, is very small.

The U.K. operating rules equivalent to FAR 121, Air Navigation (General) Regulations, paragraph 7, were already in place in 1974 to require that account be taken for the surface condition of the runway, and that a proper V_1 should be used, including full engine failure accountability under all conditions. However, at that time the U.K. certification basis, British Civil Air Regulations Section D, only required the scheduling of all engines contaminated runway data. This was permitted because contaminated conditions are fairly infrequent and short-lived in the U.K. Emphasis was placed on waiting for the runway to be cleared, or for conditions to improve. The notable exception to the lack of engine failure data was Concorde, which had full engine failure accountability since its entry into service in 1976.

As JAR 25 Change 13 certification rules (which provided detailed engine failure accountability criteria for contaminated runways) became effective (18 October 1988), engine failure data has been more widely available, enabling full compliance with the U.K. Air Navigation (General) Regulations. In general, with the increased use of de-rated thrust and reduced thrust takeoffs, the need for all-engines-operating performance to get airborne is reduced. It became unreasonable to perpetuate the old position, born of necessity, and recognize that today’s aircraft generally have one-engine-inoperative (OEI) capability on contaminated runways. Since 1996, CAA in the U.K. has been encouraging operators to make the transition to JAR-OPS 1.

In Germany, Lufthansa has accounted for OEI on contaminated runways since 1972. Up to this time, the German regulations only specified taking contaminated runways into account, and did not specify if this was for all engines operating or OEI.

In France, contaminated runway accountability has been required since 1974, but the regulations did not specify whether it was based on all-engines-operating performance or OEI performance. However, if an AFM contains engine-out data for contaminated runways, the operators are required to use it. Air France has accounted for OEI on contaminated runways since 1972.

The availability of OEI data in the AFM depends on whether or not the type certification regulations require it in the country where the airplane is certified. For example, all Airbus models are delivered with OEI contaminated runway performance data in the JAA AFM in compliance with JAR-25 requirements. (Per FAA requirements, these data may be provided as guidance information in the unapproved section of the FAA AFM, but as guidance are not required to be used by the operator.) Embraer provides data in the AFM for both all-engines-operating and OEI performance on contaminated runways to JAA operators. For FAA certification of the EMB 135/145, there is no approved data for contaminated conditions, since the FAR does not require it. Boeing provides OEI contaminated runway performance in the JAA approved AFM's for the 747-400, 777-200, 757-300, and 737-600/700/800 since these models were certified to JAR-25. For Boeing models that were not certified to JAR-25, but need to operate in compliance with JAR-OPS 1, supplementary OEI contaminated runway performance data has been made available to the operators.

At present, there are 33 member states in the JAA, and 16 member states in the European Union. Since JAR-OPS 1 was adopted by JAA in 1995, there were questions about how it could become law in those individual countries. Legal issues regarding implementation of JAR-OPS 1 in the countries of the European Union have been resolved, and it is anticipated that these requirements will become law in those countries as "EU-OPS 1" in the near future.

<u>Conclusions and Recommendations of "Aircraft Take-off Performance and Risks for Wet and Contaminated Runways in Canada," a report prepared for Transport Canada in May 1994 by Sypher:Mueller International Inc</u>.

The purpose of this study was to develop recommendations to improve operational safety for Canadian aircraft taking off from wet runways, or runways contaminated with snow, slush, or ice. The study found that as a result of increased drag, reduced friction, and reduced directional control, accident risks on takeoffs from wet and contaminated runways are greater than acceptable and that the JAR standards reduce these risks. Although the costs were found to typically exceed the benefits if the passenger payload must be reduced to include engine failure accountability for contaminated runway conditions, the risks involved in takeoffs from wet and contaminated runways without accounting for the conditions were found to be unacceptably high. Costs and the impact on the air carriers were not found to be economically unreasonable.

The study also surveyed six operators in Germany, France, Scandanavia, the United Kingdom, and Japan to review their practices in accounting for wet and contaminated runways for takeoff. All six carriers were required by their respective regulatory authority to use approved performance data for operations from wet and contaminated runways. None of the carriers use the V_{go}/V_{stop} concept associated with not accounting for an engine failure (i.e., no single V_1 speed from which the pilot can either safely continue the takeoff or stop the airplane within the remaining stopping distance available). The carriers viewed the V_{go}/V_{stop} concept as too complicated from an operational point of view.

The study recommended that Canada take action to reduce the risks associated with operations from wet and contaminated runways by requiring wet and contaminated runway conditions to be taken into account with an engine failure. Based on the additional risk associated with the use of the V_{go}/V_{stop} concept, and the concerns raised by the carriers surveyed, it was recommended that the V_{go}/V_{stop} concept not be permitted in Canada.

For each proposed change from the existing standard, answer the following questions:

6 - What should the harmonized standard be? [Insert the proposed text of the harmonized standard here]

Part 121

FAR 121.189 Airplanes: Turbine engine powered: Takeoff limitations.

(c) No person operating a turbine engine powered airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that at which compliance with the following may be shown for the runway to be used:

(1) The accelerate-stop distance must not exceed the accelerate-stop distance available.

(2) The takeoff distance must not exceed the takeoff distance available with any clearway distance not exceeding half of the takeoff run available.

(3) The takeoff run must not be greater than the takeoff run available.

(4) The same value of V_1 must be used to show compliance with paragraphs (c)(1) through (c)(3) of this section.

(5) On a wet or contaminated runway, the takeoff weight must not exceed that permitted for takeoff on a dry runway under the same conditions.

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(e) In determining maximum weights, minimum distances and flight paths under paragraphs (a) through (d) of this section, correction must be made for–

(1) The pressure altitude at the airport;

(2) The ambient temperature at the airport;

(3) The runway surface condition (dry, wet, or contaminated) and the type of runway surface (paved or unpaved);

(4) The runway slope in the direction of takeoff;

(5) Wind, including not more than 50 percent of the reported headwind component and not less than 150 percent of the reported tailwind component; and

(6) The loss, if any, of takeoff run available, takeoff distance available, and accelerate-stop distance available due to aligning the airplane on the runway prior to takeoff.

(f) Wet runway accelerate-stop distances associated with grooved or porous friction course runways may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay.

Part 135

FAR 135.379 Large transport category airplanes: Turbine engine powered: Takeoff limitations.

(c) No person operating a turbine engine powered large transport category airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that listed in the Airplane Flight Manual at which compliance with the following may be shown:

(1) The accelerate-stop distance must not exceed the length of the runway plus the length of any stopway.

(2) The takeoff distance must not exceed the length of the runway plus the length of any clearway except that the length of any clearway included must not be greater than one-half the length of the runway.

(3) The takeoff run must not be greater than the length of the runway.

(4) The same value of V_1 must be used to show compliance with paragraphs (c)(1) through (c)(3) of this section.

(5) On a wet or contaminated runway, the takeoff weight must not exceed that permitted for takeoff on a dry runway under the same conditions.

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(e) In determining maximum weights, minimum distances and flight paths under paragraphs (a) through (d) of this section, correction must be made for–

(1) The pressure altitude at the airport;

(2) The ambient temperature at the airport;

(3) The runway surface condition (dry, wet, or contaminated) and the type of runway surface (paved or unpaved);

(4) The runway slope in the direction of takeoff; and

(5) Wind, including not more than 50 percent of the reported headwind component and not less than 150 percent of the reported tailwind component; and

(6) The loss, if any, of takeoff run available, takeoff distance available, and accelerate-stop distance available due to aligning the airplane on the runway prior to takeoff.

(f) Wet runway accelerate-stop distances associated with grooved or porous friction course runways may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay.

JAR-OPS 1

JAR 1.485 General

(a) An operator shall ensure that, for determining compliance with the requirements of this subpart, the approved performance data in the Aeroplane Flight Manual is supplemented as necessary with other data acceptable to the Authority in respect of items such as:

(1) Accounting for reasonably expected adverse operating conditions such as take-off and landing on contaminated runways; and

(2) Consideration of engine failure in all flight phases.

(b) For the wet and contaminated runway case, performance data determined in accordance with JAR 25X1591, or other data ensuring a similar level of safety acceptable to the Authority must be used. (See IEM OPS 1.485(b)).

JAR 1.490 Take-off

(b) An operator must meet the following requirements for the runway to be used when determining the maximum permitted take-off mass:

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(2) On a wet or contaminated runway, the take-off mass must not exceed that permitted for a take-off on a dry runway under the same conditions.

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.
.

(c) When showing compliance with subparagraph (b) above, an operator must take account of the following:

.
.
.

(3) The runway surface condition and the type of runway surface (See IEM OPS 1.490(c)(3)).

IEM No. 2 OPS 1.490(c)(3) – Type of Runway Surface (Grooved and Porous Friction Course).

Where an identified paved runway has been prepared and maintained with a grooved or porous friction course (PFC) in accordance with a standard such as FAA AC ISO/5320-12A, or other equivalent acceptable to the Authority, performance credit may be taken, provided that approved performance data is in the AFM and is identified as appropriate for use in conjunction with a grooved or PFC runway.

Summary of Proposed Changes:

[Note: The proposed changes discussed below include more than just the changes associated directly with the issue of contaminated runway takeoff performance with engine failure accountability. This was done for completeness and clarity due to the many changes being proposed for the rule sections that address takeoff limitations. Therefore, some of the proposed changes described below will either be repeated or more fully explained in other working group reports.]

(1) Amend §§ 121.189(c) and 135.379(c) to remove the words "listed in the Airplane Flight Manual." Currently, §§ 121.189(c) and 135.379(c) require that the Airplane Flight Manual (AFM) must be used to determine the maximum takeoff weight for which compliance is shown with the field length requirements of those sections. As noted in Working Group Report 1, for most of the new performance requirements being proposed by the Performance Harmonization Working Group (e.g., runway alignment distance, retroactive application of wet runway requirements, contaminated runway requirements), airplane performance data not currently furnished in AFM's will be needed in order to

show compliance. While the working group recommends that the subject of AFM data requirements be further investigated by a working group tasked with such part 25 issues, the working group recommends proceeding with this rulemaking without waiting for that task to be completed. Until that task is completed, operators should be able to show compliance to the proposed contaminated runway takeoff limitations using supplementary data acceptable to the regulatory authority.

Removing the words "listed in the Airplane Flight Manual" from §§ 121.189(c) and 135.379(c) would leave the proposed §§ 121.173(a) and 135.363(a) (as proposed in Working Group Report 1), respectively, as the applicable requirements regarding the source of data for showing compliance with §§ 121.189(c) and 135.379(c). The proposed §§ 121.173(a) and 135.363(a) state that the performance data in the Airplane Flight Manual, supplemented as necessary with other data acceptable to the Administrator, applies in determining compliance with §§ 121.175 through 121.197 and §§ 135.365 through 135.387, respectively.

(2) Amend §§ 121.189(c) and 135.379(c) to add the words "for the runway to be used" to clarify that compliance with this requirement must be shown for the runway to be used. This is a clarifying change only.

(3) Amend §§ 121.189(c)(1), (c)(2), and (c)(3) and §§ 135.379(c)(1), (c)(2), and (c)(3) to use the terms "accelerate-stop distance available," "takeoff distance available," and "takeoff run available," which would be defined in the proposed new §§ 121.173(i) and 135.363(i). (See Working Group Report 1 for proposed accompanying amendments to §§ 121.173 and 135.363). This change would harmonize the wording of the JAR and FAR standards, but would not change the requirement.

(4) Add, as a new § 121.189(c)(4) and new § 135.379(c)(4), a requirement that the same value of V_1 must be used to show compliance with the accelerate-stop, takeoff run, and takeoff distance limitations. This requirement would ensure that, from a single defined go/no-go point (i.e., the V_1 speed), the takeoff can either be safely completed, or the airplane can be brought to a stop within the remaining distance available for stopping the airplane. Although the current FAR requires this capability through the interaction of the part 25 definitions for takeoff and accelerate-stop distances and the associated operating requirements, adding the proposed paragraph would make this requirement more explicit. With the addition of the proposed takeoff limitations for operations from contaminated runways, the proposed §§ 121.189(c)(4) and 135.379(c)(4) would clarify that these limitations must include accountability for failure of the critical engine. This clarification is considered beneficial because of the widespread availability and use of all-engines-operating data for operations on contaminated runways that will no longer be accepted for use under the proposed standard. This proposed change would also harmonize the FAR with the current JAR standard. The use of all-engines-operating data, proposed in Working Group Report 5 would not provide the capability to meet the requirements of §§ 121.189(c)(1) through (c)(3) with the same V_1 speed, and therefore would not comply with the §§ 121.189(c)(4) and 135.379(c)(4) proposed in this report.

(5) Add new §§ 121.189(c)(5) and 135.379(c)(5) to require that the takeoff weight on a wet or contaminated runway not exceed the takeoff weight permitted on a dry runway under the same conditions. It would be inappropriate, from a safety standpoint, to allow a higher maximum takeoff weight from a contaminated runway than from a dry runway under otherwise identical conditions. Without the proposed requirement, this situation could potentially occur due to differences in the methods for determining the distances used in establishing the maximum allowable takeoff weight. (In determining the contaminated runway accelerate-stop distances under this proposal, credit can be taken for the use of reverse thrust for stopping the airplane. Reverse thrust credit is not permitted in determining dry runway accelerate-stop distances. For a continued takeoff, the airplane can be at a height of 15 feet over the end of a wet or contaminated runway, but must be at a height of 35 feet (if there is no clearway) for a dry runway.) [Note: Because both wet and contaminated runways would be covered by this proposed change, this proposal is repeated in the Working Group Report 2.]

(6) Reformat §§ 121.189(e) and 135.379(e) to list, in separate sub-paragraphs, each of the items for which correction must be made. Currently, §§ 121.189(e) and 135.379(e) require correction made to the maximum weights, minimum distances, and flight paths under paragraphs §§ 121.189(a) through (d) and §§ 135.379(a) through (d), respectively, for the runway to be used, the elevation of the airport, the effective runway gradient, the ambient temperature and wind component at the time of takeoff, and, if operating limitations exist for the minimum distances required for takeoff from wet runways, the runway surface condition (dry or wet). Sections 121.189(e) and 135.379(e) also state that wet runway distances associated with grooved or porous friction course runways, if provided in the Airplane Flight Manual, may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay, and that the operator determines are designed, constructed, and maintained in a manner acceptable to the Administrator.

Under this proposal, §§ 121.189(e) and 135.379(e) would be revised to state, "In determining maximum weights, minimum distances and flight paths under paragraphs (a) through (d) of this section, correction must be made for–." "The pressure altitude at the airport" would be listed in new §§ 121.189(e)(1) and 135.379(e)(1). The use of pressure altitude instead of elevation is consistent with changes being proposed throughout this subpart. It reflects the practice that the determination of takeoff weights are normally done on the basis of pressure altitude, and that Airplane Flight Manual performance information is provided as a function of pressure altitude. New §§ 121.189(e)(2) and 135.379(e)(2) would list "the ambient temperature at the airport." New §§ 121.189(e)(3) and 135.379(e)(3) would list "the runway surface condition (dry, wet, or contaminated) and the type of runway surface (paved or unpaved)." This change would add contaminated runway surfaces to the list of runway surface conditions for which correction must be made.

The proposed new §§ 121.189(e)(3) and 135.379(e)(3) would also add a requirement to correct for the type of runway surface (paved or unpaved). This new requirement is intended to ensure that the applicable takeoff limitations for approved operations on unpaved runway surfaces, such as grass or gravel runways, are based on performance data appropriate to the type of runway surface. This proposal would codify current FAA practice, which permits operations on unpaved runway surfaces through special operational approvals under the authority of § 121.173(f). It would also harmonize this issue with JAR-OPS 1. In accordance with FAA policies developed for these special operational approvals, the limitations, procedures, and performance information for unpaved runway operation must be presented in the Airplane Flight Manual (usually in an appendix or supplement). Airworthiness certification guidance to support approval for unpaved runway operations is provided in FAA Advisory Circular 25-7A, "Flight Test Guide for Certification of Transport Category Airplanes."

New §§ 121.189(e)(4) and 135.379(e)(4) would list "The runway slope in the direction of takeoff." This item is currently listed in §§ 121.189(e) and 135.379(e) as "the effective runway gradient." The wording change would harmonize the wording with that of the JAR standard and is not intended to change the existing requirement regarding the effect of runway slope.

New §§ 121.189(e)(5) and 135.379(e)(5) would list "Wind, including not more than 50 percent of the reported headwind component and not less than 150 percent of the reported tailwind component." This would replace the criterion, "wind component at the time of takeoff," currently listed in §§ 121.189(e) and 135.379(e). The proposed wording is intended to clarify that the total wind (i.e., wind speed and direction), not just the headwind or tailwind component, must be considered. For corrections to takeoff distances, only the headwind or tailwind component is relevant. However, for flight path considerations, the total wind must be taken into account. (Note: This issue is addressed in Working Group Report 6.)

The proposed wording also includes the factors applied to the headwind and tailwind components ("not more than 50 percent of the reported headwind component and not less than 150 percent of the reported tailwind component") that are currently required by the airworthiness type certification requirements of part 25. The working group proposes that these wind factors should be applied to all operations conducted under §§ 121.189 and 135.379, regardless of the certification basis of the airplane.

New §§ 121.189(e)(6) and 135.379(e)(6) would list the new requirement proposed in working Group Report 3, "The loss, if any, of takeoff run available, takeoff distance available, and accelerate-stop distance available due to aligning the airplane on the runway prior to takeoff." (See that working group report for the reasons for this change.)

New §§ 121.189(f)/135.379(f) would contain the requirement related to operating on grooved and porous friction course wet runways currently contained in §§ 122.189(e) and 135.379(e). See Working Group Report 2 for proposed changes to this requirement.

These proposed changes to §§ 121.189(e) and 135.379(e) would harmonize the requirements contained in those sections with JAR-OPS 1.490, when amended as proposed below.

(7) Amend JAR-OPS 1.490(b) to add the words "for the runway to be used" to clarify that compliance with this requirement must be shown for the runway to be used. This is a clarifying change only.

(8) Amend JAR-OPS 1.490(b)(4) to revise the text to read, "Compliance with this paragraph must be shown using the same value of V_1 for the rejected and continued take-off." This change would replace the current words "…single value of V_1…" with the words "…same value of V_1." This change is a clarification in that there may be a range of V_1 speeds to choose from, but the intent is that the same one must be used for both the rejected and continued takeoff analyses.

7 - How does this proposed standard address the underlying safety issue (identified under #1)? [Explain how the proposed standard ensures that the underlying safety issue is taken care of.]

The proposed standard addresses the underlying safety issues by requiring operators to take into account the effect of contaminated runways (including engine failure accountability) on takeoff performance for all turbine powered airplanes operated under Parts 121 or 135. For the JAA, the proposed standard continues to require operators to take into account the effect of contaminated runways for all Performance Class A airplanes.

8 - Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Explain how each element of the proposed change to the standards affects the level of safety relative to the current FAR. It is possible that some portions of the proposal may reduce the level of safety even though the proposal as a whole may increase the level of safety.]

The proposed standard would increase the level of safety relative to the current FAR. It would add a requirement to take into account the effects of contaminated runways, including consideration of engine failure, on takeoff performance.

9 - Relative to current industry practice, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Since industry practice may be different than what is required by the FAR (e.g., general industry practice may be more restrictive), explain how each element of the proposed change to the standards affects the level of safety relative to current industry practice. Explain whether current industry practice is in compliance with the proposed standard.]

Industry practice varies, but some operators already take contaminated runways into account with engine failure accountability (or plan to do so regardless of whether this proposed standard is adopted) when determining maximum takeoff weights and V_1

speeds. Examples of operators who fit into this category include American, United, Delta, Southwest, America West, American Trans Air, and Federal Express. For these operators, the proposed standard would maintain the existing level of safety.

Other operators currently take contaminated runways into account with engine failure accountability on a portion of their fleet. Examples of operators in this category include US Airways, United Parcel Service, and Air Canada. For these operators, the proposed standard would maintain the existing level of safety for a portion of the fleet, but raise the level of safety for the portion of the fleet where engine-out contaminated runway accountability is not being applied.

For those operators who currently do not account for contaminated runways on an engine failure basis for any of their airplanes operated under parts 121 or 135, the proposed standard would increase the level of safety for takeoffs from contaminated runways, as noted in the response to item 8 above.

10 - What other options have been considered and why were they not selected?
[Explain what other options were considered, and why they were not selected (e.g., cost/benefit, unacceptable decrease in the level of safety, lack of consensus, etc.) Include the pros and cons associated with each alternative.]

The alternatives would be to harmonize on the current FAR standard, retain the current non-harmonized standards, or recommend that contaminated runways be accounted for on an all-engines-operating basis. The first option was not selected because there was a consensus that improved standards are needed to address an identified safety risk. The second option was not selected because, in addition to the reason given in the preceding sentence, it would also continue the current situation in which the JAR standard requires a higher level of safety and results in an economic advantage for FAR operators over common route with common equipment. Working Group Report 5 has been prepared in support of the third option.

The working group also examined alternatives regarding the implementation of contaminated runway requirements. Some members of the working group have proposed phasing in standards for engine failure accountability on contaminated runways over a 5 or 10 year time period. Other members are opposed to any such phase-in plan and therefore no consensus was reached. The older airplanes, such as the DC-9, MD-80, B-727, and B-737 (early models) incur the largest penalties for engine failure accountability on a contaminated runway. These airplanes represent a fairly high percentage of the total airplanes in the current U.S. fleet.

Some members have also proposed exempting smaller airplanes from the standards for engine failure accountability on contaminated runways. Other members are opposed to any such exemption for the following reasons. Smaller airplanes are no less susceptible to the performance penalties associated with operating on contaminated runways. In fact, they may be affected to a greater degree because of their size and performance characteristics. With their lower wing heights relative to the runway, smaller airplanes may be more susceptible to impingement drag caused by spray kicked up by the airplane's wheels running through the contaminant. And since smaller regional and business jets typically do not have the performance margins of the larger airplanes, the safety risk is higher. Because smaller airplanes represent a very large fleet of airplanes in the U.S., and operate into airports where runways are not aggressively cleared of contaminants, exempting these airplanes from one-engine-inoperative requirements would not provide the appropriate level of safety.

11 - Who would be affected by the proposed change? [Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.]

Operators of transport category airplanes could be affected by the proposed change because they may have to carry out additional analyses for takeoffs from contaminated runways and may realize a loss in revenue if the payload must be reduced or certain operations curtailed in order to comply with the contaminated runway requirements. Manufacturers of transport category airplanes could be affected because they generally develop the data to perform the contaminated runway analysis. However, most of these data have already been generated in order to comply with the current JAR standard.

12 - To ensure harmonization, what current advisory material (e.g., ACJ, AMJ, AC, policy letters) needs to be included in the rule text or preamble? [Does any existing advisory material include substantive requirements that should be contained in the regulation? This may occur because the regulation itself is vague, or if the advisory material is interpreted as providing the only acceptable means of compliance.]

None.

13 - Is existing FAA advisory material adequate? If not, what advisory material should be adopted? [Indicate whether the existing advisory material (if any) is adequate. If the current advisory material is not adequate, indicate whether the existing material should be revised, or new material provided. Also, either insert the text of the proposed advisory material here, or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, policy, Order, etc.)]

Advisory material, in the form of an AC, should be adopted to provide guidelines and an acceptable means of compliance with the proposed standard for taking into account the effects of contaminated runways on takeoff performance. The advisory material should allow maximum use of existing data, thus minimizing the need for developing new data. The means of compliance should include the following criteria to determine data acceptability:

1. The performance methodology for determining the effects of the contaminant on airplane braking and acceleration parameters should be based on industry standard methods, and be in accordance with JAA AMJ 25X1591 or equivalent.

2. For airplanes currently in use or airplanes of existing approved designs that will be manufactured in the future, the contaminated runway performance information need

not be furnished in the Airplane Flight Manual. This information would be considered supplementary data under the proposed revision to §§ 121.171(a) and 135.363(a). [Another ARAC working group should be tasked with determining whether the airworthiness type certification requirements should be amended to require contaminated runway performance information to be included in the AFM. That working group should also be tasked with identifying and addressing any airworthiness type certification criteria associated with determining contaminated runway performance.]

3. Consistent with the current wet runway requirements, performance credit for clearways would not be allowed for contaminated runway takeoffs.

4. One-engine-inoperative takeoff distances may be based on a 15-foot screen height.

5. Performance credit may be taken for the use of available reverse thrust in the same manner as the current Part 25 wet runway standards.

14 - How does the proposed standard compare to the current ICAO standard?
[Indicate whether the proposed standard complies with or does not comply with the applicable ICAO standards (if any)]

ICAO Annex 6 (Operation of Aircraft), Chapter 5, 5.2.6 states, "In applying the Standards of this chapter, account shall be taken of all factors that significantly affect the performance of the aeroplane (such as: mass, operating procedures, the pressure-altitude appropriate to the elevation of the aerodrome, temperature, wind, runway gradient and condition of runway, i.e. presence of slush, water and/or ice, for landplanes, water surface condition for seaplanes). Such factors shall be taken into account directly as operational parameters or indirectly by means of allowances or margins, which may be provided in the scheduling of performance data or in the comprehensive and detailed code of performance in accordance with which the aeroplane is being operated."

The current FAR does not comply with this ICAO standard in that the FAR does not require the runway condition, in terms of the presence of slush, water and/or ice to be taken into account for the scheduling of takeoff performance data. The proposed standard would bring the FAR in compliance with the ICAO standard for landplanes by requiring the effect of slush, snow, water, or ice on the runways to be taken into account.

Paragraph 5.2.8 of the same ICAO Annex and Chapter states, "The aeroplane shall be able, in the event of a critical power-unit failing at any point in the take-off, either to discontinue the take-off and stop within the accelerate-stop distance available, or to continue the take-off and clear all obstacles along the flight path by an adequate margin until the aeroplane is in a position to comply with 5.2.9."

The proposed standard, which requires engine failure accountability for takeoffs from contaminated runways, would allow full compliance with this ICAO standard.

15. – Does the proposed standard affect other HWG's? [Indicate whether the proposed standard should be reviewed by other harmonization working groups and why.]

No.

16 - What is the cost impact of complying with the proposed standard? [Please provide information that will assist in estimating the change in cost (either positive or negative) of the proposed rule. For example, if new tests or designs are required, what is known with respect to the testing or engineering costs? If new equipment is required, what can be reported relative to purchase, installation, and maintenance costs? In contrast, if the proposed rule relieves industry of testing or other costs, please provide any known estimate of costs.]

There is not expected to be a cost impact for those operators who currently take contaminated runways into account, including engine failure accountability, when determining maximum takeoff weights and V_1 speeds. Operators who do not take contaminated runways into account in this manner could suffer a loss of payload for each flight in which the takeoff weight must be reduced to comply with the proposed standard. Also, these operators will incur costs for modifying their takeoff analysis procedure to include consideration of contaminated runways.

Some operators currently account for contaminated runways with engine failure accountability for all of the airplane types in their fleets. Others account for contaminated runways, but without engine failure accountability. For others, there is a mixture of whether contaminated runways are accounted for, and whether or not it is on an engine failure basis, depending on the type of airplane. The annual costs of the proposed standard for 3 major U.S. air carriers are estimated to be about $ 10 million. One Canadian carrier has estimated annual costs of $ 39 million associated with the proposed standard.

One major U.S. carrier that accounts for contaminated runways with engine failure accountability, Southwest Airlines, analyzed the economic impact of this practice for the time period of November 1999 through May 2000. Out of a total of 446,015 departures, 0.10 percent were from runways with one-quarter inch of contaminant and 0.02 percent were from runways with one-half inch of contaminant. Out of a total operating revenue of $4,735,587,000 in 1999, $190,739 was lost due to accounting for contaminated runways on an engine-out basis. Restricting the analysis to the ten airports with the highest number of operations from contaminated runways, which included Detroit-Metro, Baltimore-Washington International, Chicago Midway, and Cleveland Hopkins, less than one-half of one percent of takeoffs were from runways with one-quarter inch of contaminant and less than one-tenth of one percent were from runways with one-half inch of contaminant.

In a regulatory analysis prepared to support potential rulemaking on this issue in the 1990 time period, the FAA projected the potential economic impact based on U.S. climatological data. For its projection, the FAA used data from the National Climactic Data Center, which collects and reports data for the average number of days per year where one inch or more of snow or sleet falls. For a representative sample of 83 major U.S. cities, it was determined that these snow events occurred an average of 9.6 days per year, or 2.6 percent of the total number of days in a year. It was then assumed that takeoffs under contaminated runway conditions would exist 50 percent of the time on days when an inch or more of snow or sleet fell, resulting in an estimate that 1.3 percent of all takeoffs in the U.S. occur on contaminated runways.

It is important to note that the need for offloading weight due to accounting for contaminated runways depends on whether the takeoff weight for the actual operation is limited by the available runway length. For takeoffs that would be runway length limited or nearly so under dry conditions, a weight offload would be required under this proposal when the runway is contaminated. Data provided by the Air Transport Association of America in a letter dated April 23,1971 indicated that the takeoff weight is limited by runway length approximately 0.5 percent of the time under dry conditions. Combined with the weather data noted in the previous paragraph, in its regulatory analysis of the proposed contaminated runway requirements, the FAA expected weight offloads to be necessary for less than 0.01 percent of departures.

It should be noted that TWA has determined that takeoff weights for their operations are limited by runway length approximately 5 percent of the time under dry conditions, rather than the 0.5 percent figure provided by United in the 1971 ATA letter quoted above. In contrast, Federal Express, Southwest, and American confirmed that the 0.5 percent figure was appropriate for their operations.

There may be some costs imposed on airplane manufacturers to develop and obtain approval of the data needed to allow operators to show compliance with the proposed harmonized standard. In general, it is assumed that data packages developed for JAR operators to facilitate compliance with JAR-OPS 1 would be acceptable to the FAA. However, there would still be costs involved in obtaining FAA approval of these data packages. Also, for airplanes not currently being operated under JAR-OPS 1, but operated under parts 121 or 135 of the FAR, new data packages would need to be developed.

17. - If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

Non-consensus on this issue is indicated by the submittal of two separate proposals – this report and Working Group Report 5.

18. – Does the HWG wish to answer any supplementary questions specific to this project? [If the HWG can think of customized questions or concerns relevant to this project, please present the questions and the HWG answers and comments here.]

No.

19. – Does the HWG want to review the draft NPRM prior to publication in the Federal Register?

Yes.

The Working Group did not reach a consensus on this issue. The following working group members support the harmonized standards proposed in this report:

Name	Organization
Don Stimson, Jim McDonald, Glenn Dail	U.S. Federal Aviation Administration (FAA)
Terry Lutz, David Hayes, Charles Ayers	Airline Pilots Association (ALPA)
Charles Prophet, John Matthews, Graham Skillen, Pierre Chevasson	Joint Aviation Authorities (JAA)
Detlef Gützlaff	Lufthansa Aeronautical Services
Ken Hurley	Spirent Systems
Brian Gleason	Southwest Airlines
David Arthur	American Airlines
Jim Brooks	Delta Air Lines
Christian Santiccioli	Air France
Nico van Eijk	KLM Royal Dutch Airlines
Hélio Tarquinio, Jr	CTA – Brazil
Aljosa Rapajic	Monarch Airlines
Graeme Catnach	British Airways

Southwest Airlines Runway Surface Condition Survey
November 1999 - May 2000

Airports with Highest Number of Contaminated Runway Operations

		Total # of Operations	Dry	Wet Good	Wet Fair	Wet Poor	0.25" Clutter	0.50" Clutter	# of Daily Departures	Equivalent Days of Clutter
1	BWI	17093	14753	2180	70	15	59	16	105	0.71
2	MDW	20379	16651	3491	153	17	66	1	116	0.58
3	MCI	12910	11776	974	96	17	41	6	72	0.65
4	BDL	2275	1724	476	32	5	36	2	13	2.92
5	CLE	3834	2954	745	90	11	31	3	21	1.62
6	PVD	4129	3314	708	69	11	25	2	23	1.17
7	GEG	2825	2011	725	51	12	24	2	16	1.63
8	OKC	3989	3621	327	14	3	9	15	22	1.09
9	DTW	3311	2724	536	30	4	14	3	19	0.89
10	MHT	2300	1827	416	35	6	15	1	13	1.23
	Systemwide	446015	408430	35690	1216	157	445	77	2516	0.21

Airports with Highest Percentage of Contaminated Runway Operations

		Total # of Operations	Dry	Wet Good	Wet Fair	Wet Poor	0.25" Clutter	0.50" Clutter	# of Daily Departures	Equivalent Days of Clutter
1	BDL	2275	75.78%	20.92%	1.41%	0.22%	1.58%	0.09%	13	2.92
2	GEG	2825	71.19%	25.66%	1.81%	0.42%	0.85%	0.07%	16	1.63
3	CLE	3834	77.05%	19.43%	2.35%	0.29%	0.81%	0.08%	21	1.62
4	MHT	2300	79.43%	18.09%	1.52%	0.26%	0.65%	0.04%	13	1.23
5	PVD	4129	80.26%	17.15%	1.67%	0.27%	0.61%	0.05%	23	1.17
6	CMH	2389	80.28%	18.50%	0.59%	0.00%	0.59%	0.04%	14	1.07
7	OKC	3989	90.77%	8.20%	0.35%	0.08%	0.23%	0.38%	22	1.09
8	RDU	2685	87.11%	11.88%	0.37%	0.11%	0.41%	0.11%	16	0.88
9	DTW	3311	82.27%	16.19%	0.91%	0.12%	0.42%	0.09%	19	0.89
10	ISP	2495	83.81%	14.75%	0.92%	0.08%	0.40%	0.04%	15	0.73
	Systemwide		91.57%	8.00%	0.27%	0.04%	0.10%	0.02%	2516	0.21

<u>Notes:</u>

Total # of Operations = Total number of takeoffs during period
# of Daily Departures = Average scheduled daily departures
Equivalent Days of Clutter = Total number of contaminated runway operations / # of Daily Departures

Lost Revenue due to Engine-out Accountability

Total Estimated Weight Loss		428,456 lb
Equivalent Passengers		2316
1999 SWA Annual Report		
Passengers Carried	57,500,213	
Operating Revenue	$ 4,735,587,000	
Revenue / Passenger		$ 82.36
Lost Revenue	**$ 190,739**	